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A web-based GIS system for debris flow hazard mapping

For debris flow hazards management a so-called Rapid Needs Assessment System was designed for two counties in Taiwan. The GIS system is based on a combination of Apache web server and / UMN Mapserver for Windows that allows for on line viewing of map layers and graphs. Risk and debris flow potential maps were prepared by using Free and Open Source GRASS GIS. The methodology and resulting system may be used by local government agencies for coordinating evacuation and protection of the population during typhoons, and other events with increased potential of debris flows.

GIS based criteria were used to calculate debris flow potential by overlaying controlling factors such as geology, slope, aspect and distance to channel.
To calculate the risk to people or property and infrastructure, the distance to buildings and roads was used. Geology, shows the 1:250,000 scale geological map of the area. The slope map is derived from a 40 * 40 m Digital Elevation Model (DEM). Aspect, shows the directions of slopes from 0 to 360 degrees. Risk of aspects is derived from rules that give different risk for different aspect depending on one of four most probable typhoon directions. Watershed, shows all streams and rivers in the area. FOS risk shows the so called 'failure-of-slope' risk. A table with risk factors for slope and geology was combined with a raster map of all possible combinations of slope and geology. Watershed risk weight shows the risk based on distance to streams and rivers. The number of streams was so large that buffering was not possible due to a lack of memory. Therefore, it was decided to first make a raster map of the streams map. After that the raster was expanded in steps of 40m and overlays were made to derive a distance to stream map. Population, shows the population numbers for different towns in 2005. Buildings and main facilities show the location of housing and other buildings. Roads layers shows three levels of roads. Since the secondary roads and small mountain roads would be too many if zoomed out to full extend, it was decided to only show secondary roads from a scale of 1:150,000 and larger and mountain roads from a scale of 1:50,000 and larger. A database of historical debris flows can be viewed and was also used in risk calculations as shown below. Rain Gage Stations, show all Central Weather Bureau rain gages in the area. Satellite image shows two overlapping panchromatic Landsat 7 ETM+ images, band 8, of the area. Risk Levels, is the map calculation of ASPECT_TYPE-X * FOS-FACTOR * WATERSHED * HIST-DF * BUILDROAD. By multiplying the different risks with the building and road raster,

where buildings and roads are 1 and rest 0 a map of potential hazard areas is produced. Debris Flow Potential Area (all), shows the result of the map calculation ASPECT_TYPE-X * FOS-FACTOR * WATERSHED * HIST-DF, so without taking buildings and roads into account. The map is slightly different for different typhoon events because of the aspect. The Investigation Area (Risk 4&5), BoO (Level 3), EFO (Level 2) and Safer Area (Level 1) are the individual layers with corresponding risk levels and also indicate location of stations and safe areas for evacuation of people in case of a typhoon event.

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